



Energy+Environmental Economics

CPUC Workshop on Societal Cost Test

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Purpose of this workshop

- + Start the discussion on the Societal Cost Test
- + Present representative values and their impacts
 - CO2 cost
 - Criteria pollutant health impacts
 - Social discount rate
- + Gain stakeholder feedback on the use of such societal values
- + Hear thoughts on other societal values that could be quantified and included



Agenda

- + Societal Cost Test (SCT) overview
- + Sample candidates for SCT
 - Discount rate
 - Carbon cost
 - Health benefits
- + SCT cost-effectiveness examples
- + Stakeholder views on the use of the societal cost test
- + Discussion of other societal values



Cost Test Perspectives

Societal Cost Test

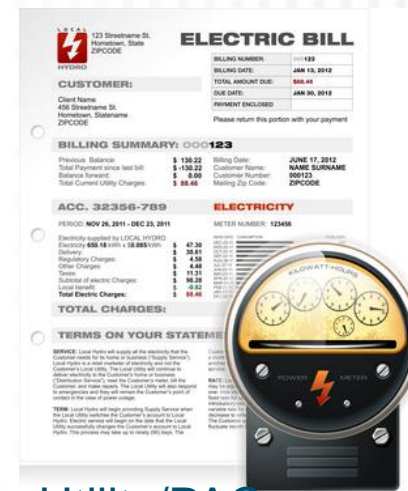
Total Resource Cost Test



Participant



Non-participant (RIM)



Utility/PAC





Standard Practice Manual

Cost Tests

Cost Test		Key Question	Summary Approach
Participant Cost Test	PCT	Will the participants benefit over the measure life?	Compare costs and benefits of consumer installing the measure; important for incentive design
Utility/ Program Administrator Cost Test	UCT/ PAC	Will utility bills decrease?	Comparison of program administrator costs to supply side resource costs; values EE on a similar basis as IRP
Ratepayer Impact Measure	RIM	Will utility rates decrease?	Comparison of administrator costs and utility bill reductions to supply side resource costs; Only looks at impacts to non-participants
Total Resource Cost	TRC	Will the total costs of energy in the utility service territory decrease?	Comparison of program administrator and customer costs to utility resource savings
Societal Cost Test	SCT	Is the utility, state, or nation better off as a whole?	Comparison of society's costs of energy efficiency to resource savings and non-cash costs and benefits



Standard Practice Manual on SCT

- + SCT is a “secondary” test that attempts to quantify total resource costs to society as a whole, rather than only to the service territory (the utility and its ratepayers)
- + Enumerated differences from the TRC test
 1. SCT may use higher marginal costs than TRC if a utility faces marginal costs that are lower than other utilities or out-of-state suppliers.
 2. Tax credits are treated as a transfer payment in the SCT, and thus are left out.
 3. Interest payments are considered a transfer payment since society actually expends the resources in the first year. Therefore, capital costs enter the calculations in the year in which they occur.
 4. A societal discount rate should be used.
 5. SCT should include externality costs of power generation not captured by the market system.



Standard Practice Manual on SCT, 2

Societal benefits specifically listed in SPM:

- + Avoided environmental damage
- + Benefits of increased system reliability
- + Non-energy benefits of reduced water use and waste streams.
- + Non-energy benefits for low income programs.
- + Benefits of fuel diversity



SCT Inputs – The Big Three

- + Societal discount rate
 - + Health costs of electricity production
 - + Environmental costs above current market price forecasts
-
- + Ranges are intended to provide food for thought and illustrate the impact of different approaches to the valuation of key drivers



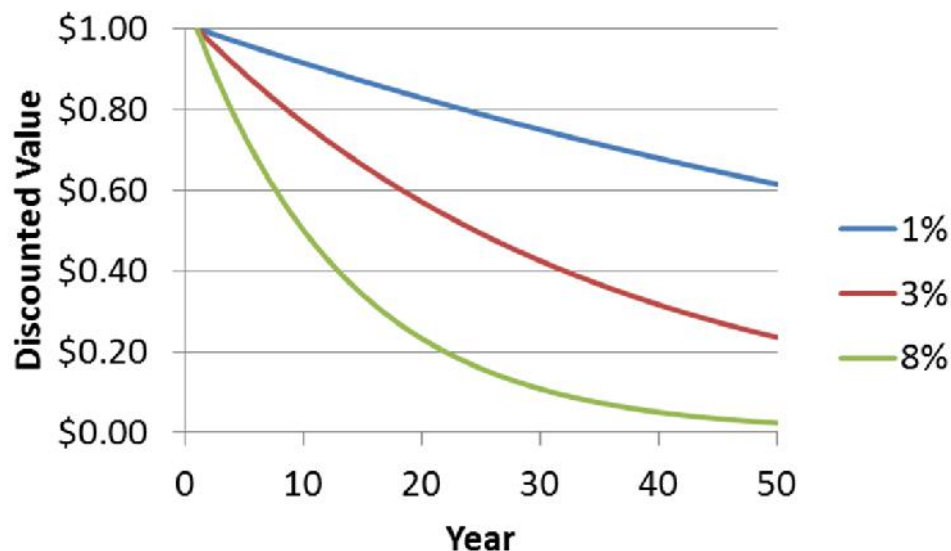
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Social Discount Rate



Key driver: social discount rate

- + Needed for valuing benefits in the future
- + TRC discount rate is currently about 7.6%
- + Social discount rates are generally lower



Present value of \$1 per year benefit over 30 years.

Discount Rate	Present value
1%	\$26
3%	\$20
8%	\$12



Theoretical (philosophical) underpinnings

+ Why do individuals, societies discount future costs and benefits?

(Textbook answers)



- Capital is productive, can be invested elsewhere, has an opportunity cost
- People care more about current than future utility
- Uncertainty or anticipated decrease in future utility
- People care less about the welfare of future generations



Most states use government securities for SCT discount rate

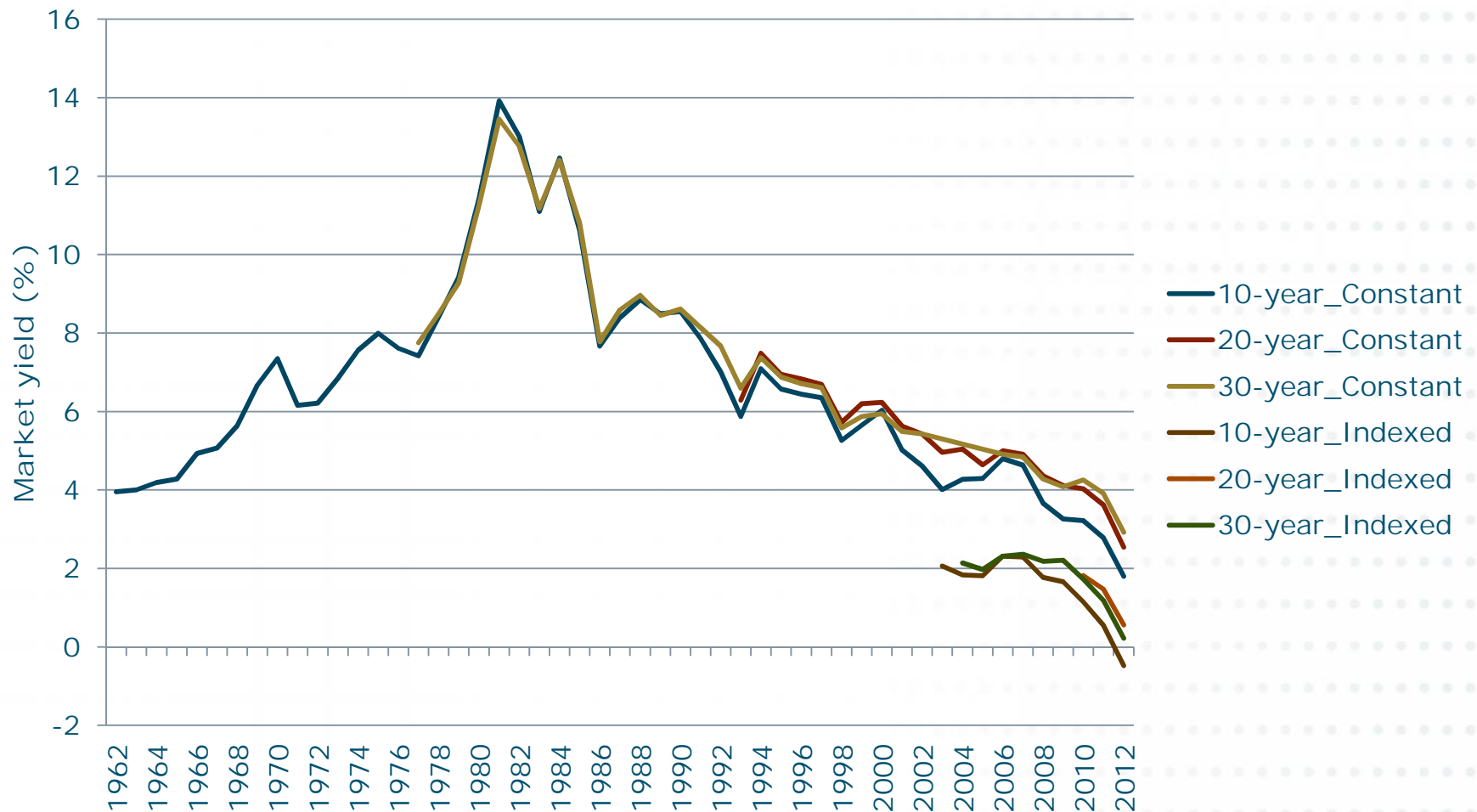
State	Basis for Discount Rate	Program Design; Source of Funds
DC	10-year T-note	Administered through DC Energy Office; system benefits charge (SBC)
Iowa	12-month average of 10-year T-note and 30-year T-bond	Administered through utilities; tariff rider
Maine	10-year T-note	Administered through Efficiency Maine Trust; SBC
Minnesota	20-year T-note	Administered through utilities; integrated resource planning (IRP)
Vermont	3%	Administered through Efficiency Vermont; SBC

Sources: Forster, HJ, S Price, I Hoffman, 2013. Cost Effectiveness is WACC! The Need for More Effective, Comparable, and Comprehensive Cost Assessment; ACEEE website



Yield on government securities can be volatile

Figure. Market yield on 10, 20, and 30-year Treasury securities, constant maturity and inflation-indexed





Rate of return on government securities

- + Use long-term (10, 20, 30-year) government securities (Treasury notes/bonds) with comparable maturity as proxy, either
 - average over several months, often one year
 - simple average of high and low rates in a year
- + In principle should be inflation-adjusted and after federal income tax; in practice these adjustments appear to be often ignored



Proxy based on long-run average rate of return on government securities

- + A fixed numerical value tied to the long-run cost of government borrowing is convenient and stable
- + “Recent studies and reports have generally found government borrowing rates [real, pre-tax] in the range of around 2 percent to 4 percent” * (EPA, 2000)
- + Examples of application of this approach
 - Vermont SCT uses 3%
 - OMB guidelines recommend 3% for government projects

* “OMB (2003) cites evidence of a 3.1 percent pre-tax rate for ten-year U.S. Treasury notes. According to the U.S. Congressional Budget Office (CBO) (2005), funds continuously reinvested in 10-year U.S. Treasury bonds from 1789 to the present would have earned an average inflation-adjusted return of slightly more than 3 percent a year. Boardman et al. (2006) suggest 3.71 percent as the real rate of return on ten-year U.S. Treasury notes. Newell and Pizer (2003) find rates slightly less than 4 percent for thirty-year U.S. Treasury securities. Nordhaus (2008) reports a real rate of return of 2.7 percent for twenty-year U.S. Treasury securities. The CBO estimates the cost of government borrowing to be 2 percent, a value used as the social discount rate in their analyses (U.S. CBO 1998).” (EPA, 2000)



Ramsey formula

- + Based on a model of economic growth and inter-temporal consumption choices by British mathematician Frank Ramsey



The social discount rate is the sum of pure time preference and a term reflecting the diminishing marginal utility of consumption



What discount rate to use in the SCT?

"... those looking for guidance on the choice of discount rate could find justification for a rate at or near zero, as high as 20% and any and all values in between."

Portney and Weyant, 1999, "Introduction,"
Discounting and Intergenerational Equity,
Resources for the Future Press





Discount rates used in this analysis

Lower



Higher

1.4% real

Source: Stern (2006)

Pros: Reflects intergenerational equity

Cons: Controversial

3% real

Source: Est. long-run avg yield on govt securities

Pros: Precedent, consistency, stability

Cons: Proxy basis



Selected Literature on Social Discount Rate

- + U.S. Environmental Protection Agency (EPA), 2000, Guidelines for Preparing Economic Analysis. EPA, Washington, DC.
- + U.S. Office of Management and Budget (OMB), 2003, Circular A-4, Regulatory Analysis, OMB, Washington, DC
- + P. Portney and J. Weyant, eds., 1999, Discounting and Intergenerational Equity. Resources for the Future, Washington, DC.
- + J. Zhuang, Z. Liang, T. Lin, and F. De Guzman, 2007, "Theory and Practice in the Choice of Social Discount Rate for Cost -benefit Analysis: A Survey," ADB ERD Working Paper No. 94, http://www2.adb.org/Documents/ERD/Working_Papers/WP094.pdf
- + Yale Symposium on the Stern Review, 2007, Yale Center for the Study of Globalization, <http://www.ycsg.yale.edu/climate/forms/FullText.pdf>.
- + S. Frederick, G. Loewenstein, and T. O'Donoghue, 2002, Time Discounting and Time Preferences: A Critical Review, Journal of Economic Literature, Vol, XL, pp. 351-401



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Non-Energy Benefits



Non-Energy Benefits (NEBs)

+ NEBs included in this analysis

- Value of CO2 reductions above the monetized cost of AB32 allowances already included in the TRC
- Health benefits of reduced electricity generation and natural gas combustion beyond existing compliance costs included in TRC

+ Partial list of NEBs not currently included

- Water savings
- Reduced waste streams
- Reduced land use impacts
- Macroeconomic benefits
- Privatized non-energy benefits such as greater comfort or productivity of participants
- Lifecycle costs of electricity and natural gas consumption (drilling etc)



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Non-Energy Benefits: Social Cost of Carbon



Social Cost of Carbon (SCC)

- + Carbon costs are already reflected in TRC tests in limited manner
 - Increased market cost of electricity due to cap and trade
 - Higher cost of procurement for RPS
- + All of the current TRC carbon costs are meant to reflect near-term expected cost outlays for compliance or mitigation
- + SCT perspective takes into account the Social Cost of Carbon (SCC) that is not captured in the TRC. SCC can be approached in two different ways:
 - Approach 1: Long-term damage costs from climate change
 - Approach 2: Electricity decarbonization cost



SCC Approach 1: Damage Cost

+ Damage to society from GHG emissions:

- Damage costs are the impact on society's total productive output and aggregate welfare due to climate change
- These costs arise from GHG-induced changes in agricultural production, hydrology, sea level, human health, ecological health, extreme weather severity and frequency, etc

+ Damage cost calculation includes these general steps:

1. Calculate the total economic costs of climate change for different equilibrium CO₂ concentrations and trajectories, and the resulting changes in radiative forcing and earth's mean surface temperature
2. Estimate the marginal damage cost of carbon by calculating the cost differences resulting from small changes in carbon emissions on equilibrium CO₂ concentrations and trajectories
3. Discount marginal damage costs to present value measured in \$/tonne CO₂



SCC and Integrated Assessment Models (IAMs)

- + SCC is calculated using integrated assessment models (IAMs):
 - IAMs typically combine economic, emissions, atmospheric physics, and climate impact models in one package (hence “integrated”)
 - IAMs determine SCC as the point at which the marginal cost of mitigation equals the marginal benefit of avoided damages
 - IAMs are meant to inform policy makers of the economically optimal level of emissions mitigation
 - There are different IAMs using different methods; all have some type of damage function
- + US federal government’s Interagency Working Group on Social Cost of Carbon has developed SCCs for use in federal regulation
 - In 2009, Obama administration ordered federal agencies to develop a common methodology for calculating SCC
 - Based on analysis using three prominent IAMs (DICE, FUND, PAGE), in 2010 the working group produced a set of SCC values that vary based on discount rate & other factors
 - US EPA used the resulting value from the Working Group in its Mercury and Air Toxics Standards (MATS)
 - US DOE has used the SCC to evaluate costs and benefit of federal appliance standards, including those for microwave ovens



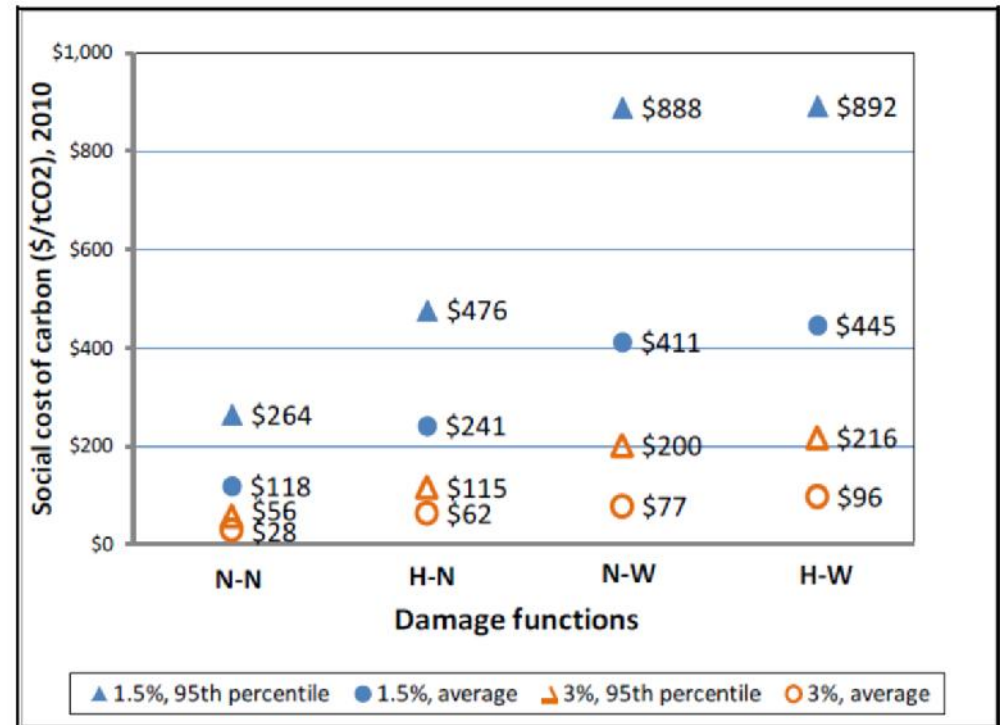
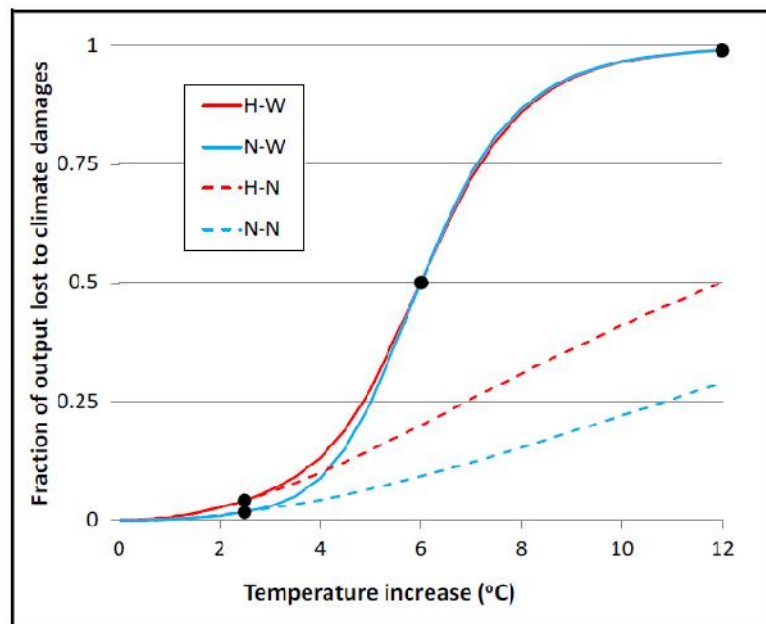
Different Assumptions Lead to Wide Variation in Results

- + Economic growth and emissions scenarios
- + Economic response to control measures
- + Uncertainty about climate sensitivity
- + Uncertainty about shape of the damage function
- + Damages not included
- + Treatment of low probability, high consequence events
- + Time horizons
- + Equity weighting
- + Risk aversion
- + Discount Rate



Damage Cost Sensitivity

- A recent study (Ackerman and Stanton, 2012) shows SCC results can vary widely, even using the same model (DICE) and many of the same assumptions





SCC Approach 1: Potential Value Ranges

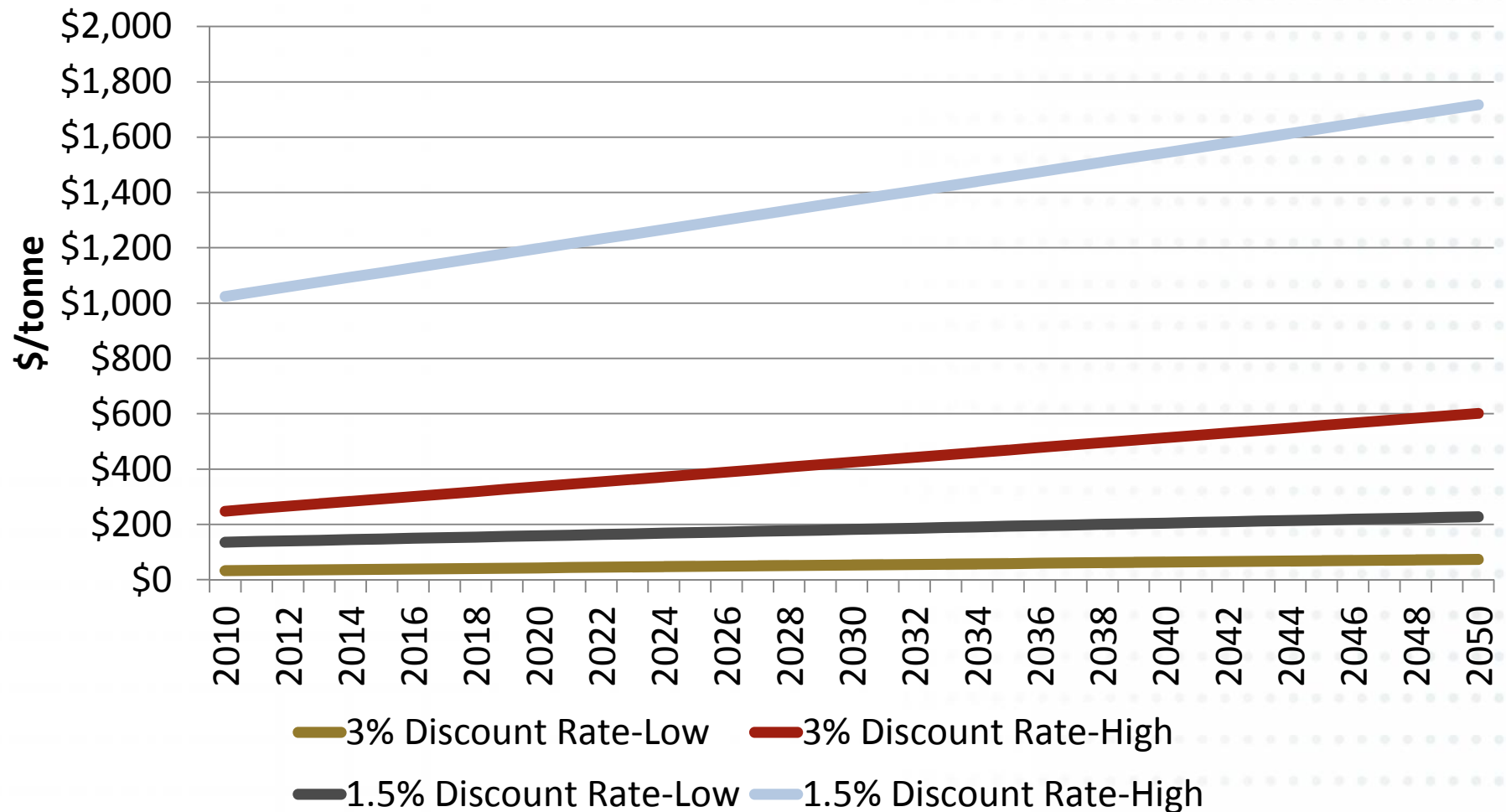


Chart derived from (Ackerman and Stanton, 2012)

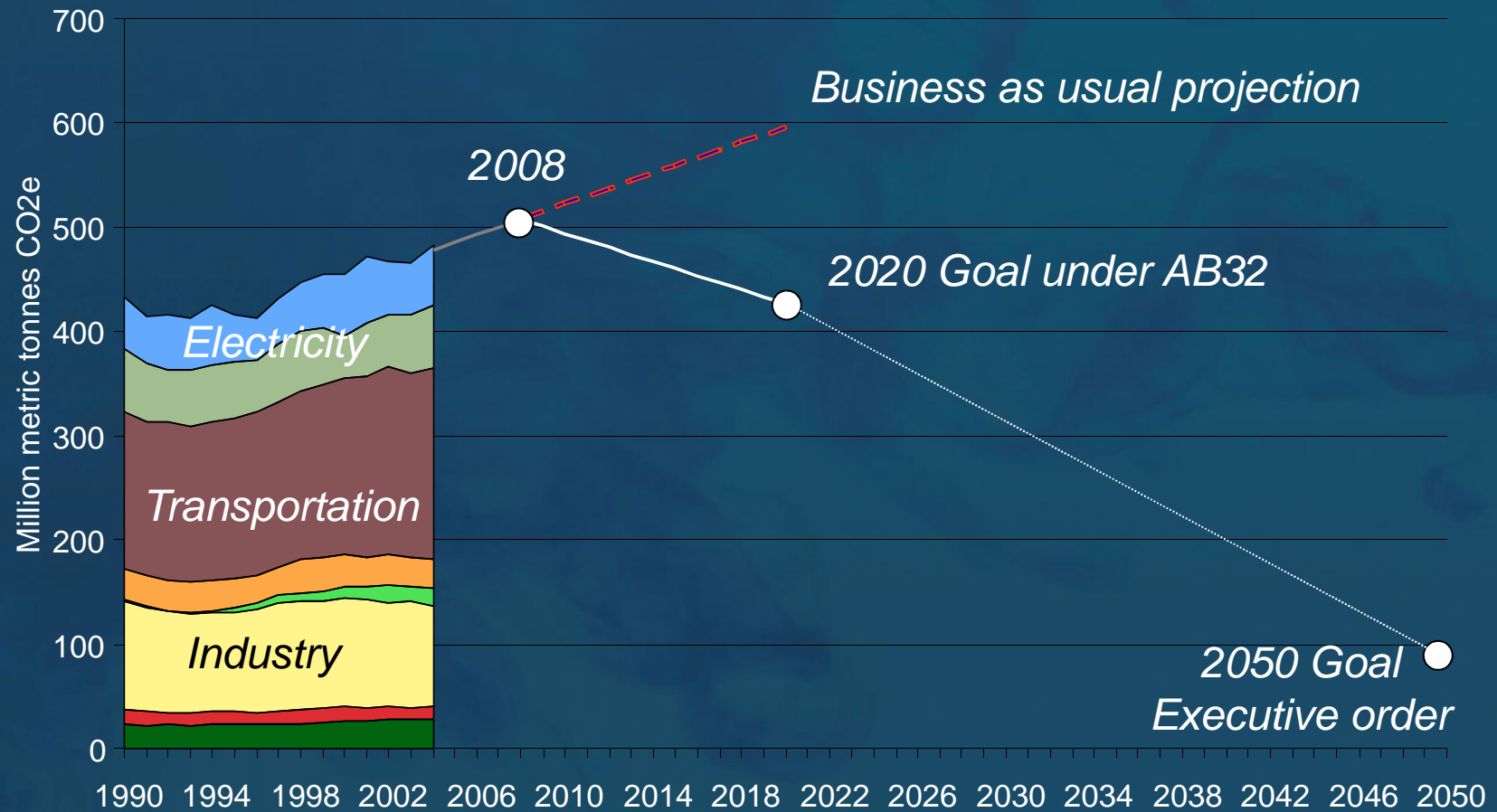


Marginal Abatement Cost Approach

- + Damage function approach intended to help policy makers set carbon targets. If target is already set, the implied carbon cost is the marginal cost of abatement
- + “If policy makers decide upon a 2 degree target, then the appropriate social cost of carbon to use is the shadow price associated with that path.” (Nordhaus)
- + Most scenarios for eliminating carbon dioxide emissions as rapidly as technologically feasible require spending \$150 to \$500 per ton of reductions of carbon dioxide emissions by 2050. Examples:
 - UK 2°C scenario: \$165-\$495/tonne
 - IEA BLUE Map 450 ppm: \$175-\$500/tonne
 - Potsdam Institute 400 ppm: \$150-\$500/tonne
 - McKinsey 480 ppm: \$90-\$150/tonne



California's GHG Emission Goals





SCC Approach 2: Avoided Electricity Decarbonization Cost

- + Long run electricity decarbonization costs provides an alternative approach to the SCC in California**
 - Reflective of established GHG reduction policies
 - Potentially higher level of certainty about underlying costs
 - Consistent with driving investment in known opportunities for climate mitigation
- + In determining the avoided costs of carbon reductions, we can compare mitigation costs in EE to an “avoided electricity decarbonization cost” of alternative investments**
- + Market price of CO₂ in cap and trade system is not an appropriate guide for EE investment because:**
 - Capped emissions are relatively small share of total mitigation. Market price likely does not reflect actual marginal cost of mitigation.
 - If CO₂ price is returned to ratepayers through revenue recycling, it would be a net zero cost in the electricity sector



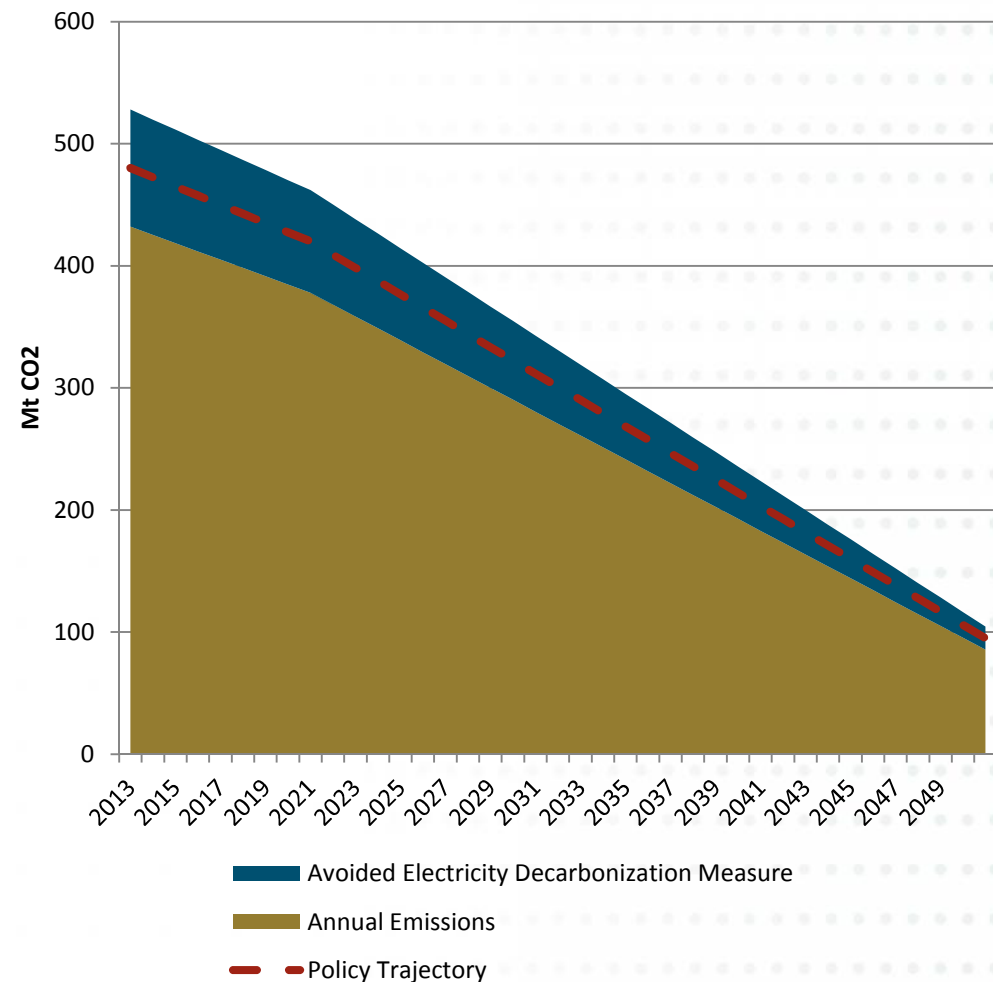
Electricity Decarbonization

- + California's multi-agency Climate Action Team established a mitigation cost range for meeting 2020 climate goals between -\$528/tonne to \$615/tonne
- + Considered electricity decarbonization measures (California Solar Initiative) to be marginal mitigation measure
- + Meeting long-term climate goals requires decarbonization and expansion of the electricity sector (electric vehicles, appliance fuel switching, etc.) according to analysis conducted separately by E3, California Council on Science and Technology, and UC Davis



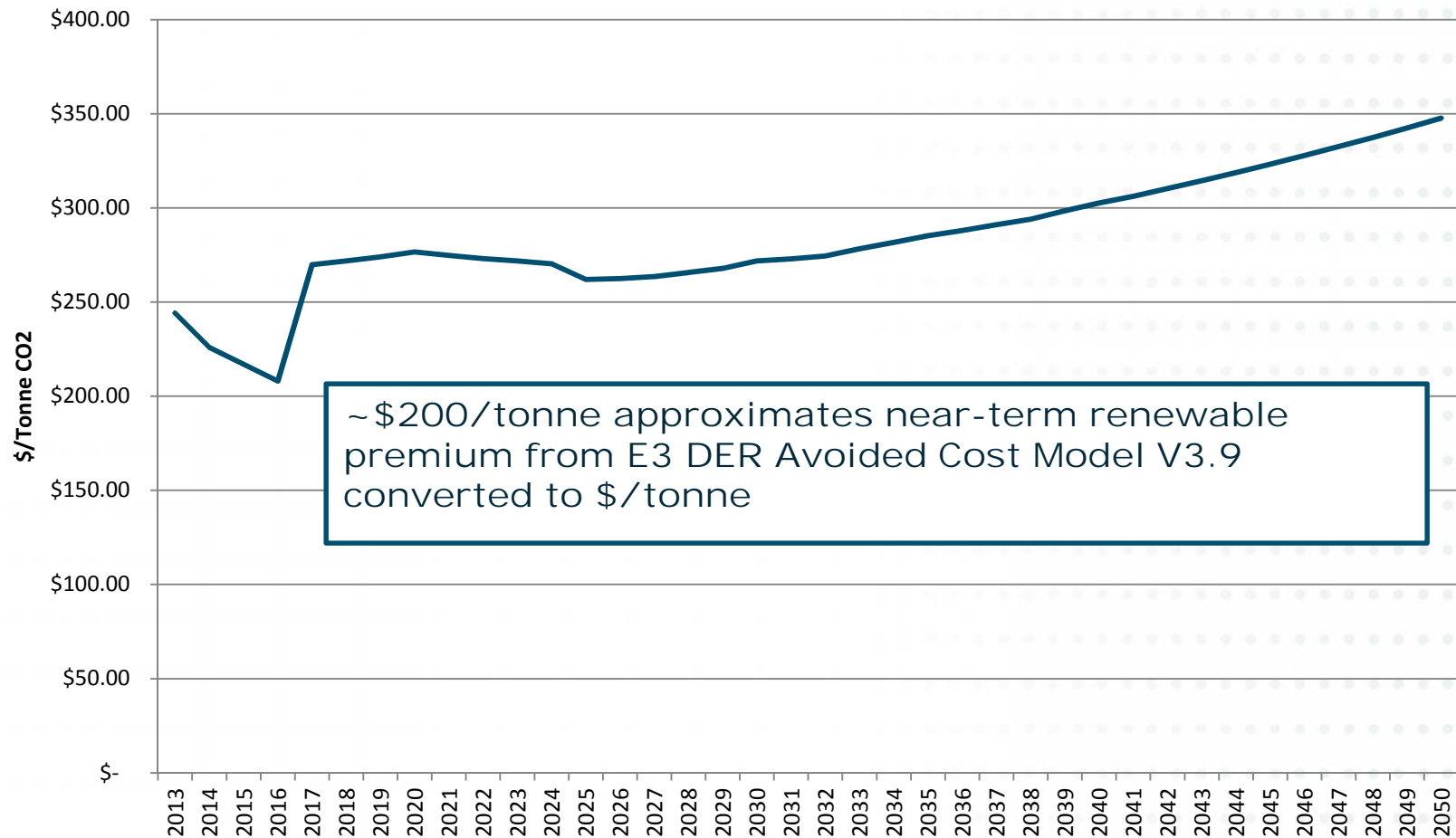
Avoided Electricity Decarbonization Cost Approach

- Annual Emissions Targets
 - Proposed Policy Trajectory in this example sets annual targets following straight line from 2013 to 2020 AB32 target, followed by straight line from 2020 to 2050 target
- Avoided decarbonization cost is the annual avoided cost (\$/tonne) of the marginal supply side electricity decarbonization measure in each year
 - If we don't do X amount of least cost decarbonization measure we will have to do Y amount of the marginal supply-side decarbonization measure
- Approach based on annual emissions targets is consistent with existing California climate policy
 - Reflects actual decarbonization costs, not carbon prices in residual cap and trade market
 - Follows policy trajectory linking AB32 and S. 3-05 goals
- Also consistent with established California policy concerning preferred resources (i.e. loading order)



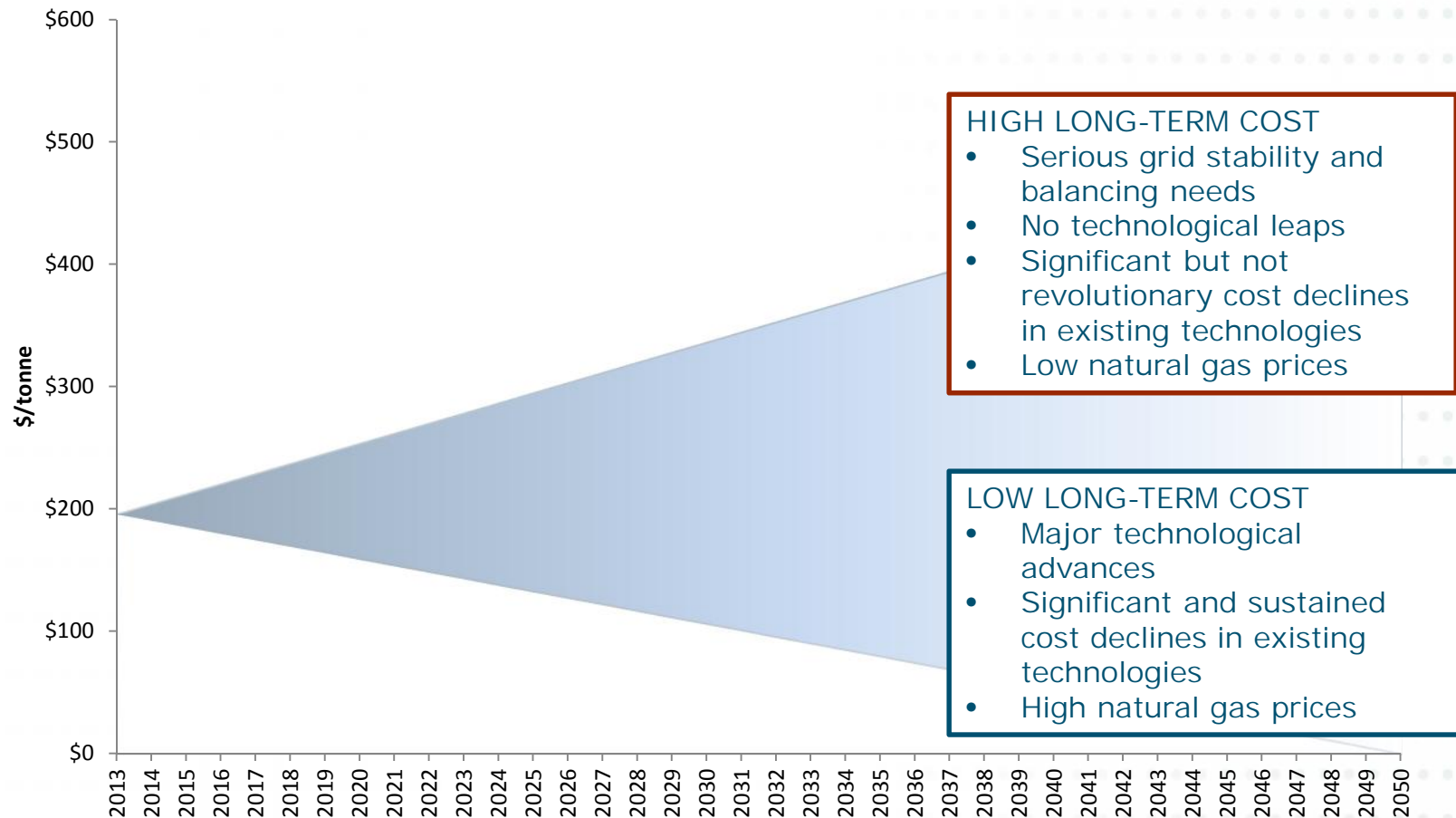


Implied Electricity Decarbonization Cost (\$/tonne CO₂): Current View





Decarbonization Cost Range Could Vary Widely in the Future





SCC Summary

+ SCC Approach 1: Damage Cost

	2010	2050
Lower	\$32	\$73
Upper	\$1,024	\$1,717

+ SCC Approach 2: Avoided Electricity Decarbonization Cost

	2013	2050
Lower	\$200	0
Upper	\$200	\$500



Selected Literature for Social Cost of Carbon

Source	Author	Description
Social Cost of Carbon for Regulatory Impact Analysis	Interagency Working Group on Social Cost of Carbon, United States Government	Uses three integrated assessment models to calculate monetized damages associated with “changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services.”
Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis	Interagency Working Group on Social Cost of Carbon, United States Government	Technical update to above report. Utilizes updated versions of integrated assessment models.
Climate Risks and Carbon Prices: Revising the Social Cost of Carbon	Ackerman, Frank; Stanton, Elizabeth	Utilizes DICE model to simulate the effect of different discount rates, damage cost functions, and climate sensitivities on the social cost of carbon
The social cost of carbon in U.S. regulatory impact analyses: an introduction and critique	Johnson, Laurie T.; Hope, Chris	Critiques the “Social Cost of Carbon for Regulatory Impact Analysis” by updating discount assumptions and equity weights.
Estimates of the Social Cost of Carbon: Background and Results from the RICE-2011 Model	Nordhaus, William	Uses the RICE-2011 integrated assessment model to estimate damage costs.
Stern Review	Stern, Nicholas	Calculates marginal social cost of carbon based on policy trajectory using PAGE2002 integrated assessment model.
The Social Cost of Carbon: Trends, Outliers and Catastrophes	Tol, Richard S.J.	Meta-analysis based on 211 estimates of the social cost of carbon.
The Treatment of Risk and Uncertainty in the US Social Cost of Carbon for Regulatory Impact Analysis	Dietz, Simon	Assessment of the impact on the social cost of carbon of changing the probability distribution of damage cost function.




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Non-Energy Benefits: Avoided Health Costs



Non-GHG Environmental Costs of Electricity and Natural Gas

- + Emissions impacts  Initial focus, most literature available
 - NO_x , SO_2 , $\text{PM}_{2.5}$, PM_{10} , Hg
- + Land use impacts
 - Land footprint and intensity of impacts vary by tech. type
- + Water use impacts
 - Consumptive/non-consumptive, fresh water/salt water, etc.
- + “Lifecycle” environmental & other impacts
 - Fuel and mineral extraction, waste processing & storage
 - Tourism impacts from reduced air quality
 - Ecosystem impacts from sulfur and nitrogen deposition



Current Representation of Air Emission Costs in Cost Effectiveness Framework

+ Criteria Pollutant Emissions

- Environmental compliance costs are captured in the cost of new generation
- NO_x and PM_{10} costs are based on RECLAIM trading credit costs and CARB emission reduction credits costs
- What the TRC does not currently capture: The above are compliance costs and do not address the damages to society for emissions that escape the stack



Health Benefits in other Jurisdictions

- + Minnesota: Pollutant specific values for PM_{10} , CO, NO_x , Pb, CO_2
 - Based on survey of existing values in literature
- + Maine: Non-Energy Benefit (NEB) factors for environmental externalities
 - Also includes O&M Reductions, other fuel, water savings, and other NEBs where quantifiable
- + Other states embed Health Benefits in a simple adder that includes other NEBs
 - 10% used by Colorado, Washington, Oregon, DC
 - 15% used by Vermont.
 - 7.5% for gas and 10% for electricity in Iowa



Health Benefits Quantification: Avoided Damage Costs

- + Health damages result from air emissions, which lead to exposures, which lead to health impacts, which lead to costs to individuals and society
- + There is an extensive literature on environmental health impacts due to air pollution
- + Two main approaches to determining societal health cost benefits of avoided air emissions:
 1. Using emission factors from the scholarly/regulatory literature
 2. Calculation of damages using air quality and exposure assessment tools



Damage Cost Sources

1. Emission factor from the literature approach:
The National Academy of Sciences "Hidden costs of energy", 2009, represents the most recent consensus based, and comprehensive scientific assessment of the issue
 - Damage costs are estimated for 498 gas fired power plants
 - http://www.nap.edu/catalog.php?record_id=12794
2. Calculation approach: Air quality and exposure assessment tools
 - EPA uses the BenMAP tool for estimate health benefits from proposed air quality regulations
 - EPA developed a simplified damage cost estimator, COBRA
 - Other tools (e.g. APEEP)

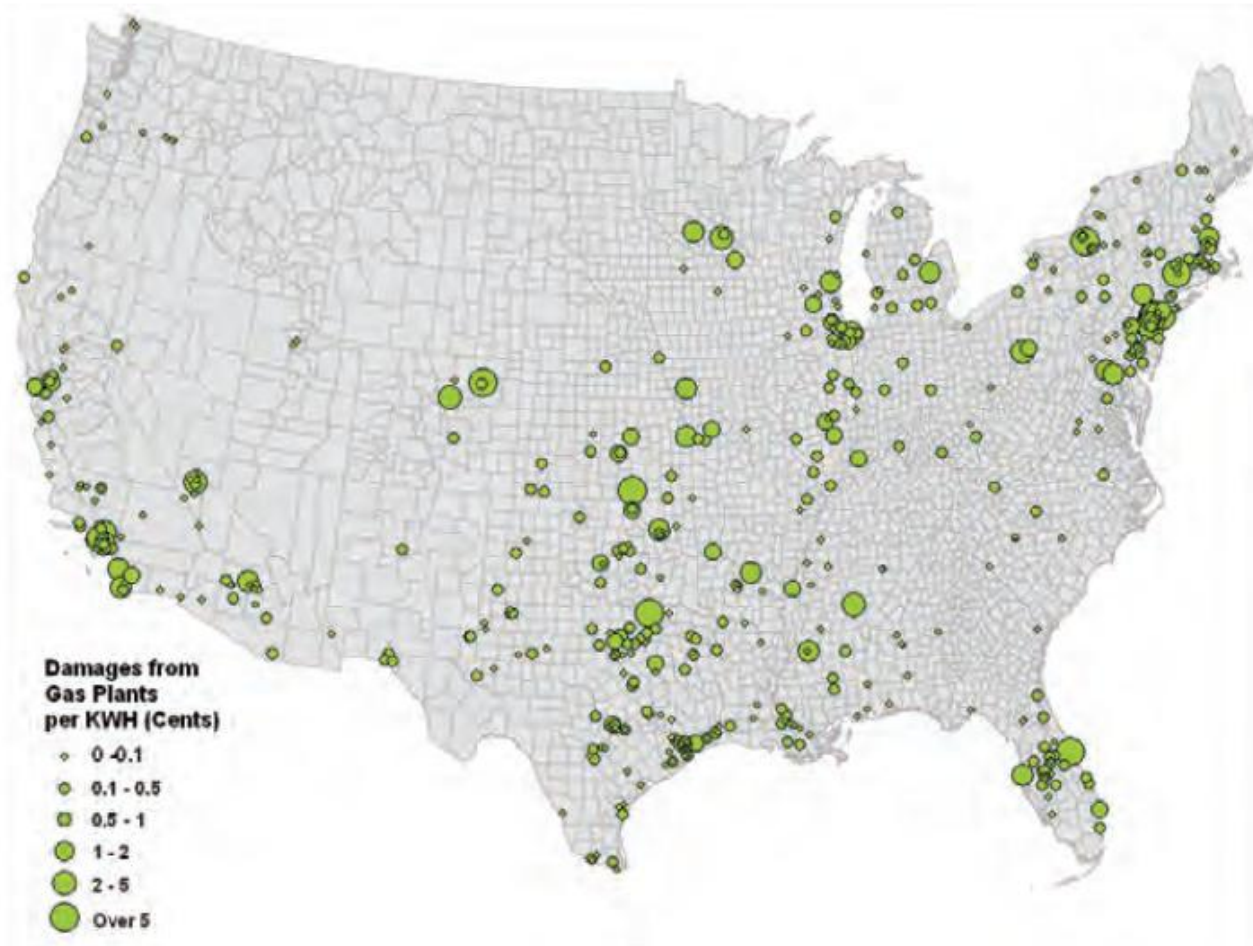


Emissions factors from the Hidden Costs of Energy report

- + Damages related to emissions of NO_x , SO_2 , PM_{10} and $\text{PM}_{2.5}$ for natural gas plants
 - + Health damage costs driven by exposure to particulate matter (PM), either directly emitted or formed in atmosphere from precursor emissions of NO_x and SO_x
 - Includes electric utilities, IPPs and CHP facilities; all > 5 MW
- + Distribution of damages (\$2007) on a kWh-weighted basis:
 - Mean: \$0.16/kWh;
 - Median: \$0.036/kWh;
 - 25th percentile: \$0.01/kWh; 75th percentile: \$0.13/kWh;
 - The distribution is skewed with very dirty generators causing the mean to be significantly larger than the median



Distribution of damages: Hidden Costs of Energy report



Natural gas plants in California exhibit a range of damages from less than 0.1 ¢/kWh to over 5 ¢/kWh for a few plants in Southern CA

FIGURE 2-17 Regional distribution of criteria-air-pollutant damages from gas generation per kWh (U.S. dollars, 2007). Damages related to climate change are not included.



Exposure assessment tools used by US EPA: COBRA and BENMAP

- + BenMAP ('Benefits Mapping' tool) is a tool developed by the EPA that estimates the benefits to the population from changes in air pollutant concentrations
 - Used by EPA to conduct impact analysis of proposed regulations, such as the Mercury Air Toxics Rule (MATS)
- + COBRA ('Co-Benefits Risk Assessment' tool) is a simplified screening tool developed by the EPA to estimate benefits from changes in air pollutant emissions in 2017 (the year modeled for MATS)
 - Intended user is a state agency interested in understanding the air quality or health benefits from clean energy



Example of Cobra Estimate Components

- + Sample health impact and damage costs for Alameda County based on a 1 ton per year average reduction of PM_{2.5} across California in 2017

	Low-Case		High Case	
	Incidence	Cost	Incidence	Cost
Adult Mortality	0.0002	\$1,831.30	0.0006	\$4,712.59
Non-fatal Heart Attacks	0	\$3.42	0.0003	\$31.81
Infant Mortality	0	\$3.86		\$3.86
Resp. Hosp. Adm.	0.0001	\$2.32		\$2.32
CDV Hosp. Adm.	0.0001	\$2.43		\$2.43
Acute Bronchitis	0.0004	\$0.18		\$0.18
Upper Res. Symptoms	0.007	\$0.46		\$0.46
Lower Res. Symptoms	0.0049	\$0.21		\$0.21
Asthma ER Visits	0.0002	\$0.08		\$0.08
MRAD	0.2264	\$15.39		\$15.39
Work Loss Days	0.0383	\$5.78		\$5.78
Asthma Exacerbations	0.0073	\$0.84		\$0.84
\$ Total Health Effects		\$1,866.28		\$4,775.96

Damage costs dominated by mortality

High and low estimates in COBRA based on two authoritative studies, by ACS (Krewski) & Harvard (Laden)



Example: Illustrative Damage Costs Using COBRA

- + Benefits to Californians due to reductions of NO_x , $\text{PM}_{2.5}$, SO_2 in California in 2017 are considered (benefits to nearby states are excluded)
- + Electricity Generation
 - Reductions occur uniformly across California in 2017
 - Emissions factors from the CARB RES calculator are used to convert \$/ton into \$/MWh and \$/MMBtu
 - Damage costs (in 2017) ~ \$8/MWh - 20/MWh (\$2010) (equivalent to \$1/MMBtu - \$2.5/MMBtu at 8000 Btu/kWh heat rate) NAS estimate is \$36/MWh
- + Natural Gas
 - Emissions from commercial and institutional boilers category reduced by EE or DER measure
 - Damage costs (in 2017)
 - ~\$1/MMBtu - \$3.5/MMBtu (small boilers)
 - ~\$1.3/MMBtu – \$4.70/MMBtu (large uncontrolled boilers)



Selected Literature for Health Benefits

- + BenMAP tool: <http://www.epa.gov/air/benmap/>
- + COBRA tool: <http://www.epa.gov/statelocalclimate/resources/cobra.html>
- + California Air Resources Board, 2010, Estimate of premature deaths associated with fine particulate pollution (PM2.5) in California using a U.S. Environmental Protection Agency Methodology
- + Hubbell BJ, Fann N, Levy JI., 2009. Methodological Considerations in Developing Local-Scale Health Impact Assessments: Balancing National, Regional and Local Data. Air Quality Atmospheric Health doi: 10.1007/s11869-009-0037-z [online 31 March 2009].
- + Industrial Economics, Inc., 2010. Uncertainty analysis to support the second section 812 Benefit-Cost analysis of the clean air act. Draft Report. Prepared for the Office of Air And Radiation, U.S. Environmental Protection Agency. Available at http://www.epa.gov/air/sect812/may10/IEc_Uncertainty.pdf
- + Krewski, D., et al., 2009. Extended follow-up and spatial analysis of the American Cancer Society study linking particulate air pollution and mortality. Res Rep Health Eff Inst(140), 5-114; discussion 115-136. <http://europepmc.org/abstract/MED/19627030/reload=0;jsessionid=XK12yJWmrnJBaG6nOB6X.26>
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- + Miller, B., Hurley, F., Shafrir, A., 2011. Health impact assessment for the national emissions ceiling directive (NECD) – methodological issues. Research Report TM/11/03. Available at <http://ec.europa.eu/environment/air/pollutants/pdf/IOM%20Report%20methodology%20NECD%20HIA.pdf>
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- + Synapse Energy Economics, 2010. Cobenefits of renewable energy and energy efficiency in Utah. Air quality, health and water benefits. A report to the state of Utah.
- + Tagaris E, Liao KJ, Delucia AJ, et al., 2009. Potential impact of climate change on air-pollution related human health effects. Environ. Sci. Technol. 43: 4979—4988.
- + U.S. Environmental Protection Agency (U.S. EPA). 2011. Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards. Office of Air Quality Planning and Standards, Research Triangle Park, NC. December. Available: www.epa.gov/mats/pdfs/20111221MATsfinalRIA.pdf
- + U.S. Environmental Protection Agency, 2011b, Regulatory Impact Analysis: National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters [Boiler MACT]



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Scenario Values

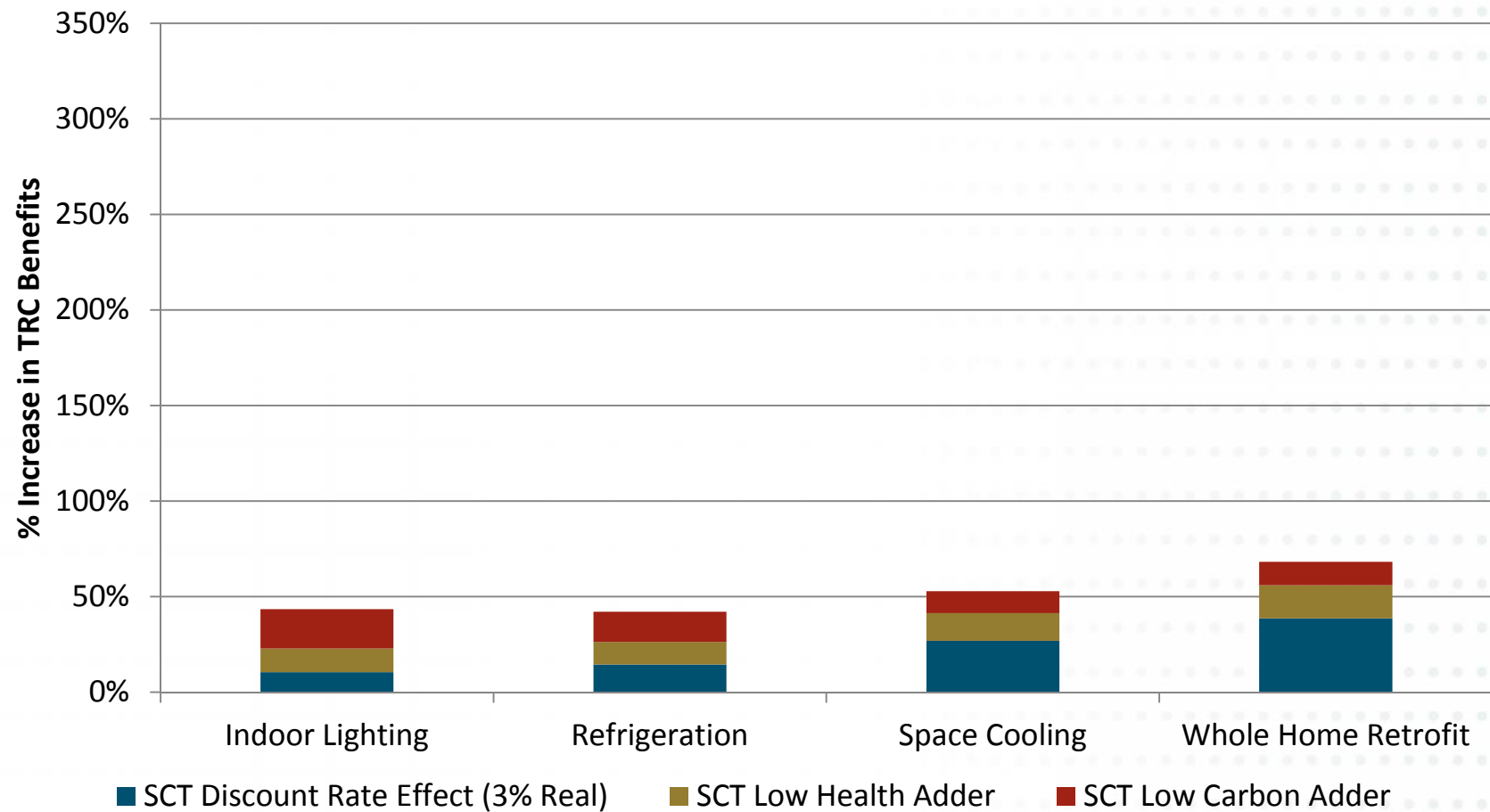


Values for Scenario Runs

Key Driver	Low Case	High Case
Societal Discount Rate	3.0% real	1.4% real
Cost of Carbon	\$50/t CO ₂	\$200/t CO ₂
Health Benefits	\$1/MMBtu	\$2.5/MMBtu

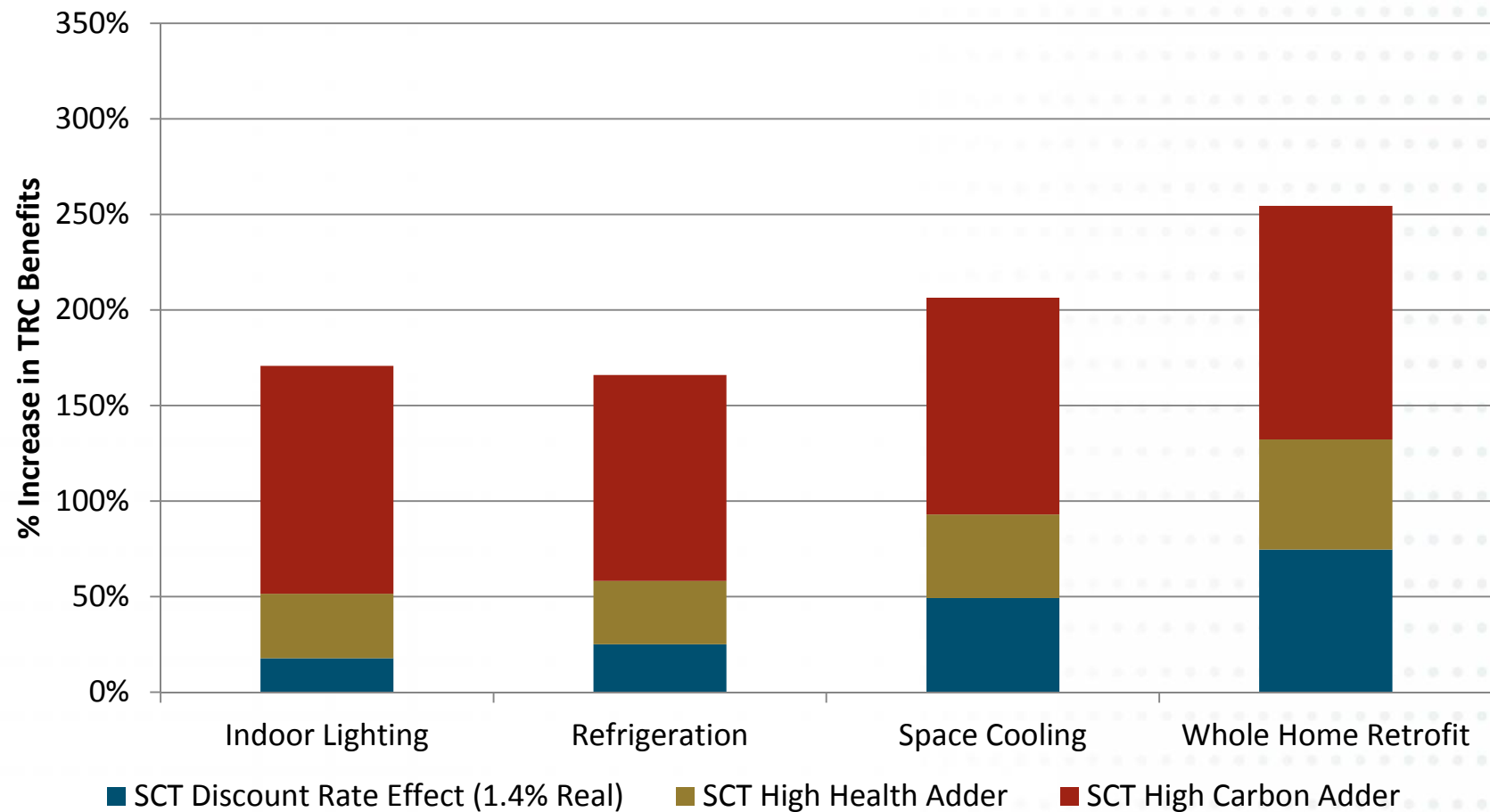


SCT Benefits Increase Over TRC – Low Case





SCT Benefits Increase Over TRC – High Case





Discussion Topics

- + What are other non-energy benefits that could be quantified and included in an SCT?
- + How could SCT impact California?
 - Increase EE programs and implementation
 - What new new programs would we expect?
 - Increase incentive levels
 - If incentives were limited to TRC benefits, could using the SCT still increase EE implementation?
 - Return California to leadership position
- + How should SCT be used in California?
 - Apply only to certain types of EE programs?